E12

FEDERAL UNIVERSITY OF TECHNOLOGY OWERRI
SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY
DEPARTMENT OF ELECTRICAL /ELCTRONIC ENGINEERING
2018/2019 RAIN SEMESTER EXAMINATION

Course: PSE 312 – Electric Power Systems and Machines — 25[th] October, 2019
Instruction: Answer five questions only — Time: 3 hours

SECTION A (Answer any **two** questions)

A1.(a) Define load flow studies (LFS) as used in power system and state its two uses. (6marks)
(b) State and explain any three LFS methods (6marks)
(c)State and explain three types of buses used in LFS (8marks)

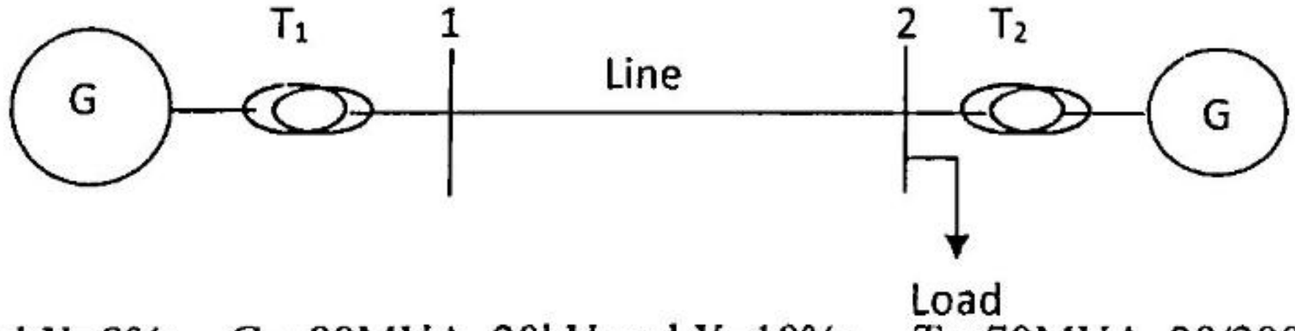
A2(a)(i)What is a Y-bus and state its significance in power system? (4marks)
(ii)Using a two bus system, develop a model for determining the elements of a Y-bus (6marks)
(b)Sketch a 3-bus power system having series impedances of j0.5, j0.2 and j0.4 ohms b/w buses 1-2, 1-3 and 2-3 respectively and shunt impedances of -j20 ohms in each of the lines linking the buses given that line 1-3 is a long line while the other two are medium lines. (6marks)
(c) Using formulae developed in question 2a(ii), determine the Y-bus for the system you sketched in question 2(b). (4marks)

A3(a) From 1st principle, develop the equations for Apparent Power (S), Real Power (P) and Reactive Power (Q) of a multi-bus system with bus"i" source and bus "j" as receiving. (10marks)

(b) Given that Jacobian matrix J= $\begin{matrix} J1 & J2 \\ J3 & J4 \end{matrix}$, Determine the four equations represented by J1, J2, J3 and J4 respectively by determining the partial derivatives of change in P and Q derived in Q3(a) with respect to voltage angles and magnitudes respectively (10marks).

SECTION B (Answer at least **one** question)

B1 a. What are the advantages of P.U system?
b. Draw the p.u impedance diagram and find the equivalent Thevenin reactance for the electric power system shown below using base of 100MVA and base voltage equivalent to the ratings of the equipment. The ratings are as shown in the diagram.



G_1=80MVA, 20kV and X=9%; G_2=80MVA, 20kV and X=10%; T_1=70MVA, 20/200kV and X=18%; T_2=70MVA, 200/20kV and X=25%; Line= 200kV, X=200Ω; Load=200kV, S=82<52.43^0 MVA.

B2 a. Explain the different types of faults in power systems
b. Two generators connected to a bus bar is connected through a step up transformer to a transmission line. Another generator is connected to a bus and through a transformer to the opposite end of the transmission line, a load and a motor are connected to each bus. Draw both the one-line diagram and the impedance diagram of the network. Insert nine number Circuit Breakers with the fourth and sixth open while the rest are closed to the network.

SECTION C SECTION C (Answer at least **one** question)

C1 a. Write short notes on (i) lap winding (ii) wave winding and (iii) frog-leg winding (6marks)
b. Draw completely the equivalent circuit of a dc motor and state the equation of (i) internal generated voltage and (ii) induced torque developed by the machine (7 marks)
c. State two reasons that justifies the placement of the low- voltage winding innermost and the primary and secondary windings of the transformer one wrapped on top of the other (4 marks)
d. State the 3 factors the voltage of a real machine will depend on (3 marks)

C2 a. (i) State 4 losses associated with transformer construction (2 marks)
(ii) Draw the circuit model of a real transformer and label completely (5 marks)
b. Outline 4 major types of dc generator (2 marks)
c. A simple rotating loop between curved pole faces connected to a battery and a resistor through a switch has the following dimensions $r = 0.6m$, $l = 1.0m$, $R = 0.5\,\Omega$, $B = 0.26\,T$ *and* $V_B = 220v$. suppose a load is attached to the loop and the resulting load torque is 20N.m, find (i) The steady state speed, (ii)power supplied to the shaft of the machine and (iii) power supplied by the battery. (11 mks)

hysteresis.
Copper losses
Eddy losses

Serial
Shunt
differential Cmpd